California ISO
Shaping a Renewed Future

The transmission-distribution interface in 2030: Two conceptual bookends

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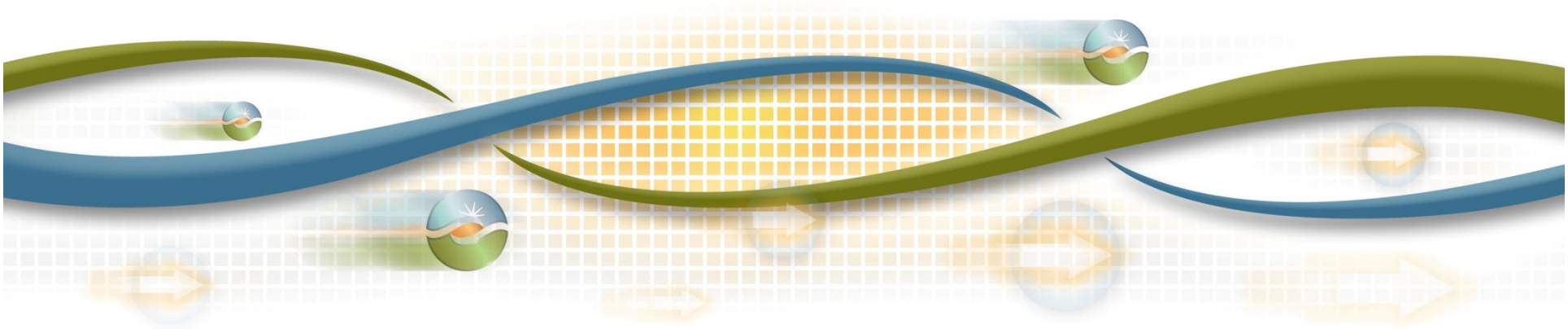
CEC IEPR Workshop, August 19, 2013



Outline of presentation

- The forces of change
- Two concepts of the future T-D interface
- Other elements of a 2030 power system vision
- Some policy considerations

The forces of change

- Policies to reduce environmental impacts of energy
- Diverse, rapidly emerging technologies
  - Inexpensive solar PV; electric vehicles; storage; micro-grid systems; automation; small-scale & “community” resources
- Customer desires for greater choice and control
  - Dynamic automated demand response
  - Desire for local resilience to disturbances

Possible 2030 implications:

- Increasing local production of end-use kWh
- Proliferation of micro-grids with islanding capability

Why envision possible future T-D interface?

- Change is inevitable – better to be proactive than purely reactive
- Consider near-term policy issues from a whole-system perspective, rather than piecemeal
- Proliferation of distributed energy resources requires explicit focus on T-D interface
- Consider possible entry of new types of participants, with new roles and responsibilities
- Possibility of anticipating needed innovations and starting now to develop them (Resnick 2012)

The two conceptual bookends

- Bookends are expressed as “pure” or extreme models in order to clarify the differences
  - Neither one is necessarily preferred at this time
  - But both are plausible futures, so it is prudent to anticipate how they might work in practice
  - Not mutually exclusive; instances of both could co-exist for many years
  - Bookends represent conceptual “end states” – without yet considering possible transition paths to these states
- Bookend A: T+D comprise a fully integrated system, with one system operator that performs scheduling, real-time balancing, integrated markets, etc., and traditional T-D boundary is eroded for purposes of markets and operations.
- Bookend B: T and D are separate systems that meet at well-defined T-D interface points (e.g., PNodes), with a transmission system operator for the transmission grid and wholesale markets, and separate entities operating & balancing the distribution systems.

Comparing the two bookends

Bookend A	Bookend B
• ISO schedules and dispatches integrated T+D system to maintain real-time balance & reliability • ISO has visibility & dispatches distributed resources above a low size threshold (e.g., 50 or 100 kV)	• ISO operates transmission grid only (i.e., up to the PNode) • Distribution system operator (DSO) operates distribution system below each PNode • PNode is similar to an intertie • DSO is similar to a micro-grid
ISO provides real-time services (balancing, load following, frequency, etc.) for distributed resources as well as grid-connected resources	• ISO provides real-time services for grid-connected resources • DSO provides RT services for distributed resources • DSO at each PNode is a resource from ISO perspective

Other elements of the 2030 power system

- Greater coordination & integration across the western interconnection
  - Real-time imbalance markets in different areas that together include most of the western region
  - Day-ahead coordinated scheduling & congestion management largely eliminate unscheduled flows
- Greater efficiency in use of west-wide grid may offer potential to optimize access to renewable-rich areas without massive infrastructure investment

Some policy considerations

- Policy makers can influence – but not fully control – the ultimate trajectory of industry evolution
- Is there a "least regrets" approach for near-term policy issues that allows the optimal future structure to be realized?